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The Marine Laboratory
Institute Of Marine Science
UNIVERSITY OF MIAMI

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A SUGGESTED OUTLINE FOR THE MEGASCOPIC DESCRIPTION OF MARINE SEDIMENTARY CORES

by

Gene A. Rusnak and Stanley J. Luft

to

The Office of Naval Research
Contract Nonr 4008 (02)

MIAMI 49, FLORIDA

THE MARINE LABORATORY
CORE DESCRIPTION AND PREPARATION ROOM

INSTITUTE OF MARINE SCIENCE
The Marine Laboratory
University of Miami

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INTRODUCTION

The most important single source of marine geological information is found in the sedimentary record which is impressed upon the deposits of the marine environment. The lithologic description, classification and interpretation of these deposits can only follow from an adequate collection of representative sample. The advances of modern piston and gravity coring devices over the past two decades have provided a means whereby controlled sampling of the marine sedimentary section can be made rapidly and systematically. This advance has resulted in accelerated knowledge about the nature of the marine deposits and in particular to the processes involved in their deposition. This fact is clearly evident in the numerous publications which herald the advent of modern marine geology and oceanography.

The information contained within the pages of recent publications comprises an impressive array of detail. Much of the information is directly comparable from one study to another, but a great deal of information is lost because a uniform descriptive core-code is not used. It is understandably impossible for an individual investigator to study all aspects of the marine sedimentary record contained in cores which he may have collected. It is essential, therefore, that marine geological cores be uniformly and adequately described so that published descriptions will be meaningful to other investigators for further study. A uniform descriptive code will help not only in synthesizing available information, but also will help guide specialists to specific cores or areas required for specialized studies. An attempt to provide a uniform megascopic descriptive procedure for marine cores is suggested in the following report. The methods suggested here make no claims for originality, but are presented merely as a unified compilation of available techniques which can be used for an acceptable form of published core descriptions. The procedures used in this report are followed by The Marine Laboratory, Institute of Marine Science, University of Maimi, and are recommended for acceptance by other investigators to establish uniformity among published studies. Undoubtedly, there will be objections to some aspects of the suggested procedures. Where objections arise, the writers will welcome any modification or changes which may become generally acceptable.

Greater detail is recorded in the examples than might be needed generally for published descriptions of cores. The detail, indicated, however, is advantageous in the laboratory record of core properties. Published records may require only a summary of this detailed description combined into a digested graphic expression of the core lithology. Laboratory records are normally made on strip logs to original scale for complex lithology in order to (1) avoid descriptive errors and (2) to provide an exact description of detail. Lithologically homogeneous cores, require only a scaled down version of the strip-log record. An example of a lithologically complex type of strip log is presented in the appendix of this report.

Acknowledgements:

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by the Office of Naval Research and the National Science Foundation. The formalization of the material presented herein could not have been possible without the backlog of knowledge which has been provided by many workers in the field here at the Marine Laboratory and The Scripps Institution of Oceanography. The writers wish especially to express their appreciation to F. F. Koczy, C. Emiliani, W. Charm for help in discussions of the problem. Many of the techniques discussed were developed during the senior author's association with Scripps. Although it is impossible to acknowledge the origin of techniques and ideas developed by many of the individuals at Scripps, M. N. Bramlette, J. R. Curray, H. Lusk, D. Poole, W. Riedel, F. P. Shepard, and Tj. H. Van Andel were especially productive sources of information. The writers of this report, however, are responsible for the layout of the present scheme and were, of course, influenced by personal bias which may not be acceptable to their associates. S. J. Luft is now with the U. S. Geological Survey, Denver, Colorado.

GENERAL INSTRUCTIONS

All logging normally done on a 1:1 scale.

All information should be written legibly on the strip logs.

The permanently recorded data on the strip logs should be inked in with a "Rapidograph" pen or similar finely-pointed pen utilizing India ink.

The following information is provided for the box heading each strip log:

Latitude and Longitude
Station Number
Ship and Cruise
Area and Subarea
Depth
Date (of core recovery)
Fathogram Number
Core Section, Total Core Length, and Type
Physiographic Province
Remarks
Name of Logger and Date

The strip log is divided vertically into the following columns:

I. Depth (in centimeters)
II. Classification
III. Lithology
IV. Color
V. Sampling Data
VI. Descriptive Text

The procedure for filling each column is described below.

LOGGING PROCEDURE

Under ideal conditions, the core should be described immediately

after it has been split, (longitudinally into equal halves) preferably after it has been photographed, (Figure 1) and preferably before sampling (Figure 2). Thus it will be fresh and wet, and relatively undisturbed. Both core halves are compared with each other after splitting, but only one-half will be sampled. The unsampled half section is to be sealed in a plastic "D-Tube" as an archives section.

Always try to work under the same type of conditions.

Use the same source of light for each type of operation. This is of particular importance in color determinations.

Work with a meter stick or metallic tape placed adjacent to the core.

Assume that the core was taken vertically, unless known to have been otherwise. Plane surfaces which are more or less perpendicular to the walls of the core may thus be considered as having been horizontal in their natural state.

Column I. Depth

The depth is indicated, on a 1:1 scale, on the printed strip log.

Column II. Classification

The classification of recent marine sediments proposed by Olausson (1960) is used here because it lends itself well both to megascopic determination and to graphic presentation. This classification is essentially that of Revelle (1944) modified by Arrhenius (1952).

In this column II, the numerical classification of Olausson (see Appendix A) is to be used. The purpose of this column is to numerically codify the graphic lithologic scheme of Column III.

The classification and vertical extent of any lithologic unit cannot, of course, be determined until that unit has been properly described in Column VI.

Gradational contacts should be determined as closely as possible and indicated by a dashed line; sharp contacts are to be sketched as seen.

A subdivision of Class 12 (Sand), on the basis of grain size, is necessary. The apprppriate abbreviation (see Appendix A) for the size encountered follows the number 12, e.g., 12 v fn-fn (very fine to fine sand). The procedures for the determination of grain size and for the use of abbreviations are discussed under Column VI. Descriptive Text.

It is recommended that another class (12.5) be added to Olausson's scheme, to include the gravel (more than 2 mm. in diameter) size fraction.

An example of a single lithologic unit classification might read as follow: B + 3 + 4 + 11 + 12 v fn-fn + 14 + 17 + 19. This may be translated as:

B. Terrigenous deposit, containing:

3. more than 60 per cent $CaCO_3$
4. between 10 and 30 percent **Forams**
11. silt
12. very fine to fine sand
14. detrital grains
17. Pteropods
19. any or all of the following: oolites, pisolites, nodules, and related concretions.

<u>Column III.</u> <u>Lithology</u>

Use the graphic classification of Olausson, mentioned above under Column II, and presented in the Appendix.

The patterns are to be applied carefully with the appropriate, transparent strips (such as "Zip-a-tone") which are guided by a straight edge held parallel to the column.

The following column spaces have been tentatively assigned for this work:

<u>First Subcolumn</u>

Generic classification	yellow
Proportion of calcium carbonate	black
Biological components	blue

<u>Second Subcolumn</u>

Textural properties	red
Miscellaneous components	green

This column, like Column II, cannot be filled in until the unit is properly described and classified. The indications for gradational and sharp contacts also apply here.

Ordinarily, the transparent patterned strips will be used for the entry of all patterns in graphic classification. An exception is made for entry of the textural and miscellaneous components, however. Experience has shown that the graphic description is more legible when texture and miscellaneous components are inked in by hand. Plastic transparent strips may be covered with a strip of "magic tape" (or similar material) to facilitate inking overlays.

<u>Column IV.</u> <u>Color</u>

Color determinations normally are to be made from the freshly split wet core, after it has been photographed, and before sampling or any other determinations. Should the core have dried out prior to this determination, the word <u>dry</u> should be indicated at the top of the column.

Determinations are made by direct visual comparison with the G.S.A. Rock Color Chart, and the color symbols of that chart, rather than the names, are to be used.

Where necessary, interpolations can be made between colors of the same hue. Thus, a color intermediate between 10YR 8/2 and 10YR 6/2 may be written as 10YR 7/2.

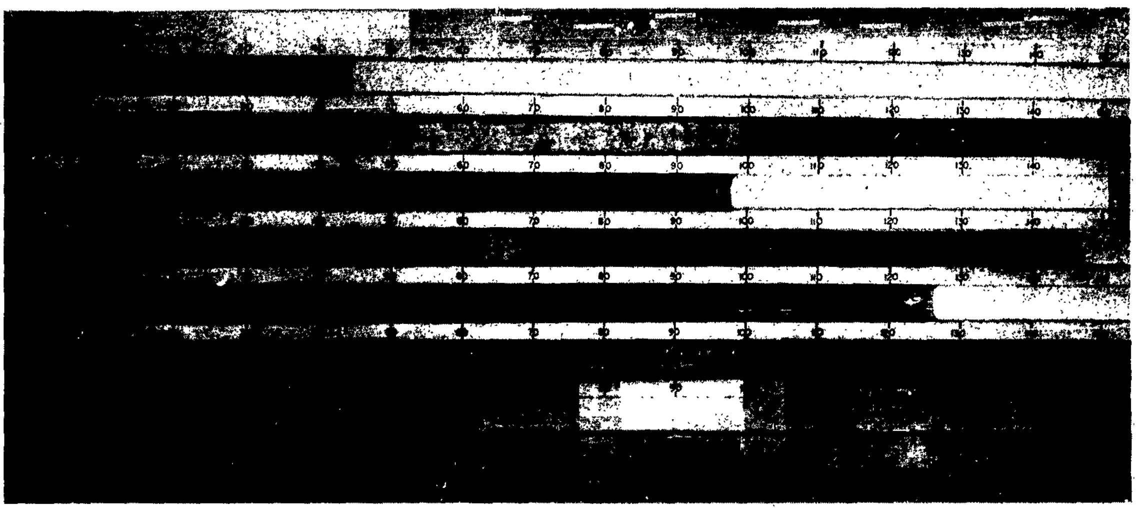

Figure 1. Upper photograph shows core section in plastic liner before it is split into equal halves, but after the plastic liner has been partially cut through with the electric saw.
Lower photograph shows general layout of core section in the "photo-rack" used to record core lithology.

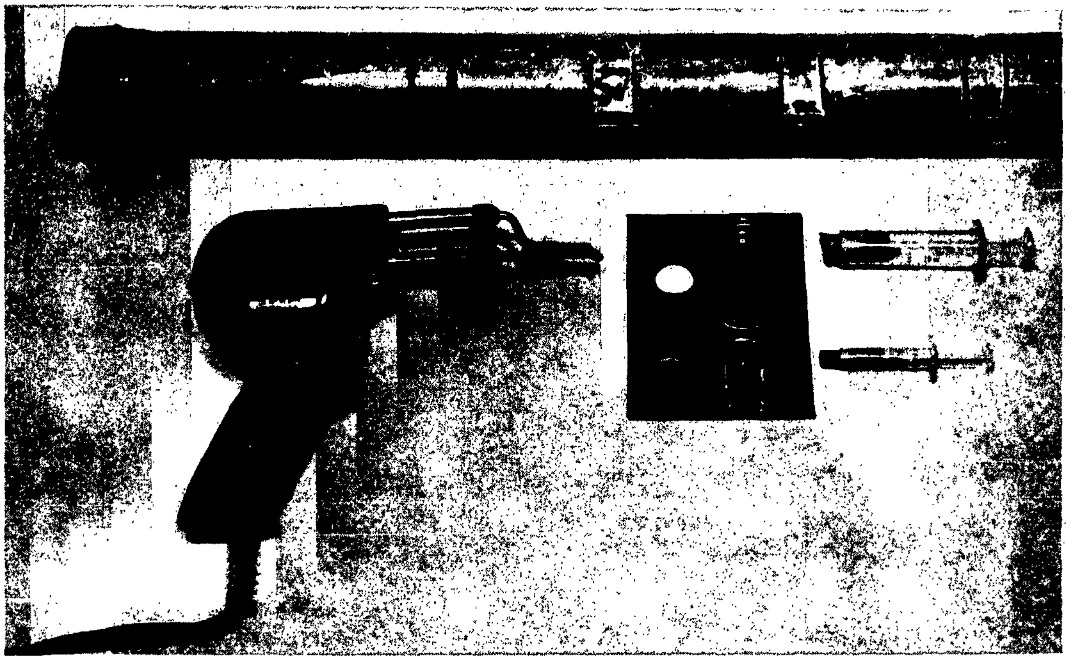

Figure 2. Upper photograph shows field technique for sampling core through plastic liner. "Door" opening is cut in liner with an electric soldering-gun having "tile-cutters" tip. Samples removed with disposable plastic syringes of appropriate size. Lower photograph shows "high-impact" polystyrene "D-TUBES" used for storing each core-half. A polyethylene envelope is placed around each core section to seal in moisture. The envelope covered section is then placed on top of a sheet of formalin soaked blotter paper and sealed in the D-TUBE. ("D-TUBES" available from Jet Specialties, 941 N. Eastern Avenue, Los Angeles, California. Storage method of "D-TUBES" developed by Scripps Institution of Oceanography)

Similarly, a color intermediate between 10YR 8/2 and 10YR 7/4 may be written as 10YR 7.5/3. Where a color lies between two hues, the dominant hue is written first, e.g., 5GY 6/1 to 5Y 6/1.

If the unit consists of one color and mottlings of another, they are to be written as in the following example: 10YR 6/2 w 5 6/1 mot (w=with, mot=mottle). Where two or more colors are intermixed in such a way that each is identifiable, they may be written as in the following example, the dominant color preceding: 10YR 8/2& 10YR 5/4 vrg (&=and, vrg=variegated).

The color symbol is to be placed in the column at the depth where it appears. A vertical arrow through the center of the column will indicate the vertical extent of the color, down to the next color symbol. If the change is gradual, the corresponding portion of the arrow should be drawn as a broken line. If the change is abrupt, a "contact" should be drawn across the column.

Thin irregular lenses of color, blotches, and other similar changes of limited extent in the color of a unit, which do not cross the entire width of the core, are to be noted in Column VI.

Column V. Sampling Data

Samples will be taken from the core, at fixed or varying intervals, for the following purposes:

1. Natural water content and specific gravity determinations, and identification of Foraminifera.
2. Grain size analyses
3. Carbonate content determinations
4. pH and Eh determinations
5. Chemical analyses
6. Paleotemperature determinations
7. Isotope-age determinations
8. Analyses for organic content
9. Petrographic studies
10. Others (identified in Column VI)

The location and vertical extent of samples removed from the core is to be indicated by blacking in the correct vertical portion of the appropriate sub-columns (which are numbered from 1 to 10, as above). In every case, each large sediment sample removed from the core will have a similarly shaped piece of inert plastic (such as styrafoam) substituted to fill the void left by the sample removal. All plastic substitutes will be appropriately marked with depth of core which they represent and purpose for which sediment sample was taken. Obviously, small scrapings for slide smears, etc., need not concern the analyst as no void is made which might later effect the position or absence of a lithologic horizon.

Column VI. Descriptive Text

All observations made during the study of the core, and particularly those which will aid in the classification of the core and its lithologic units, are to be noted in this column. Such observations should include mention of the following:

Color (except where noted in Column IV)
- Texture (grain size)

Physical character (relative firmness and dryness)
Bedding (character of contact and of bedding planes, thickness, attitude, markings of bedding surfaces, disturbances, etc.)
Nodular and concretionary structures
Organic constituents
Miscellaneous features

Some of these characteristics are more fully developed below.

METHODS FOR CLASSIFICATION

Abbreviations.

A list of recommended abbreviations is to be found in the Appendix. These should be used whenever possible because of the need to conserve space within the strip log. Where no abbreviations are indicated, the word should be spelled out. From time to time, additional abbreviations may have to be formulated.

Multiple modifying terms should be hyphenated wherever possible. Periods are not to be used; phrases and sentences may be separated by semicolons, and clauses within phrases and sentences by commas.

All persons engaged in logging and interpreting the core logs should agree on standard procedures for using the abbreviations, and on using a standardized nomenclature.

An example of the use of abbreviations in core description may be the following (compare with core log example in the appendix):

> est 20%F, cm F plates, scr rods, r/ R, scr shl frg, scr ool, v abu cal plates & frg, abu cal slt; text v fn-fn sd, w slt & md sd, w/ srtd & rndd; 5 mm Pt @ 37.5

Written out, the description would be as follows:

> The unit contains an estimated 20 percent of Forams. Foraminiferal plates are common, rods (spicules, spines, and other elongated forms of organic origin) are scarce, Radiolaria are rare, shell fragments are scarce, oolites are scarce, calcareous plates and fragments (undifferentiated calcareous material greater than 62 microns in mean diameter) are very abundant, and calcareous silt (undifferentiated calcareous material smaller than 62 microns) is common. The texture (grain size) ranges from very fine to fine sand, with lesser amounts of silt and medium sand (in order of frequency), and the sediment is well sorted and rounded (visual estimate). A Pteropod, 5 millimeters in diameter, is encountered at a depth of 37.5 centimeters.

Semi-Quantitative Nomenclature.

The frequency of occurrence of a constituent, or group of constituents,

can be estimated by using comparison charts for the visual estimation of mineral percentages, together with a binocular or petrographic microscope. The values obtained, though semi-quantitative at best, are sufficiently adequate for locating the unit within the classification of Olausson.

The units and their percentile equivalents are listed in the following table:

Percentage of Sample	Frequency Group	Abbreviation
more than 60	flood	fld
30-60	very abundant	v abu
10-30	abundant	abu
5-10	common	cm
1-5	scarce	scr
less than 1	rare	r/
1 grain	trace	tr

Determinative Procedures.

After the core has been scanned for color (see Column IV. Color) and separated into color units, it is studied for gross and detailed lithology. Very often, color "contacts" are indicative of lithologic changes and contacts. Observations are to be made and recorded on the various characteristics outlined at the beginning of the discussion for this column (Column VI).

The tools utilized here include a hand lens, binocular microscope, petrographic microscope and accessories, dissecting needle, spatula, pocket penetrometer, and standard-size grain mounts. A bottle of dilute HCl will also be useful, and other equipment may be used whenever necessary. It should be emphasized that the determination of the properties and characteristics of the core is essentially a megascopic operation. Time should not be spent on highly detailed work inasmuch as the core will be sampled repeatedly for detailed study and analysis. The results obtained from these particular studies can always be incorporated later on into the strip log, or the core can be relogged when more complete information is available.

A rapid and satisfactory method of examining cores is outlined below. It may, of course, be modified according to the type of core, and the ability and knowledgeability of the operator.

A small sample is taken from the top of the core and placed on a clean microscope slide. A drop of distilled water is added and the sample is "smeared" (spread thinly and evenly). After it has dried thoroughly at 105°C. on a hot plate, the sample is mounted under a cover slip with Caedex mounting media (n=1.55). The slide may be placed in use after only a few minutes of setting.

The components are identified with the use of a petrographic microscope, and both their frequencies and grain size are estimated.

A stage or ocular micrometer will be useful for the latter determination, or size may be estimated from the magnification. A magnification of 100X or so is most adequate for the majority of smears; higher magnifications may be necessary for samples consisting largely of silt and clay sizes, whereas a lower magnification is more appropriate for the coarser sands. Smears are not recommended for samples where the average grain size is in excess of 0.5 mm. For these, the binocular microscope is sufficiently precise. Once the operator has familiarized himself with the normal components of the cores, five minutes will be adequate time for the perusal of a smear. Other smears may be taken wherever obvious compositional or lithologic changes appear within the core.

Once the operator has, through the examination of smears, a general idea of composition and texture, he transfers the core to the binocular microscope and studies the entire core from top to bottom, while shifting his field of view from side to side across the core. A magnification of about 20X is generally sufficient for this; closer examination of individual grains may require a magnification of 30X. Grain size is best determined by visual comparison with previously sieved "comparator" grain mounts. The clean edge of a sectioned core will often give a closer approximation of the true content of the core. This is especially true where the texture is partly clayey or silty, because this finer-grained material may be smeared across the surface of the core, obscuring the sand. Additional smears may be made whenever necessary, but caution must be exercised to avoid contaminated edges or core-handling disturbances.

The following intervals of sampling for smears (to be noted in sub-column 9 of Column V) are recommended:

Always take smears from

a. the top of the core.
b. the bottom of the core. This will give an approximation of what may be present immediately below the cored section.

Usually take smears from

a. the tops and bottoms of major lithologic units.
b. the bottom of each section of a long core.

Occassionally take smears from

a. the middle of a thick lithologic unit.
b. anywhere deemed necessary by suspicious (?) lithologic or structural "disturbances".

The gross lithology of a core may, at times, be best observed with the naked eye, or with a hand lens.

Apparent dips are measured with a protractor. The angle is taken from where the plane to be measured meets the edge of the core. The depth is recorded, however, from the center of the core (as are all contacts and other plane surfaces). It is important to remember that the measured dips are only apparent ones, and that "true" dip directions

cannot be determined from the core alone.

Texture.

The texture of a lithologic unit is determined in accordance with the size of its grains and the range of their size (or sorting). Other characteristics are of lesser importance to this study.

Grain size is determined on the basis of the Wentworth scale, through actual measurement (stage or ocular micrometers, or millimeter scale), or through visual comparison with charts or specially prepared grain mount standards.

The Wentworth Scale, as Adapted for this Study

Mean Diameter mm.	μ	ϕ Values	U.S. Standard Sieve Size (retained on)	Textural Term
				Pebble (peb)
4.0	4000	-2	5	Gravel (grv)
				Granule (grnl)
2.0	2000	-1	10	Very Coarse Sand (v crs sd)
1.0	1000	0	18	Coarse Sand (crs sd)
0.5	500	+1	35	Medium Sand (md sd)
0.25	250	+2	60	Fine Sand (fn sd)
0.125	125	+3	120	Very Fine Sand (v fn sd)
0.062	62	+4	230	Silt (slt)
0.004	4	+8	minus 230	Clay (cl)

Sediments are seldom so well-sorted that their texture can consist of only one of the above size grades. Most sediments consist of two or more textural classes. The classification (Appendix E) proposed by Folk (1954) will be used for the Textural nomenclature of the Terrigenous sedimentary units. (See Appendix B, item II).

Visual estimates of sorting although very subjective will be adequate for this study to determine whether the sample (or unit) is well sorted, moderately sorted, or poorly sorted. Objective classification can only follow from a complete size analysis.

Physical Character.

The relative firmness ("unconfined" compressive strength) of the core is determined by inserting a pocket penetrometer into the core to the depth indicated on the instrument. The results are shown in terms of kilograms per square centimeter. Because this procedure disturbs the core, it should be done on the split reserved for sampling.

Readings should be taken every ten centimeters, alternately with the samples for natural water content (Column V.1), i.e., at 5, 15, 25, etc. centimeters

of depth. Readings should also be taken at the top and bottom of major lithologic units and through the center of laminae.

The results are to be plotted in Column VI as, for example, S 0.75 (compressive strength is equal to 0.75 kg/cm^2), and the location noted in Column V.10.

The relative wetness of the unit may be noted simply as fluid (or wet), damp, or dry.

The "packing" (arrangement of particles) of units may be described in terms of being loose (l/) or tight (t/). Gradations between these limits need not be mentioned as they are covered more quantitatively in the determination of relative firmness.

Bedding.

Descriptive work on the bedding and bedding plane features of the cores, and on the other characteristics which are mentioned below, requires that the operator be familiar with many aspects of stratigraphy and sedimentation. Methods, therefore, will not be discussed, and only the salient features which may be encountered during the study of the cores will be listed. The logger may refresh his memory by referring to journal articles and leading texts on the subject. Among the latter, those by Lahee (1941), Pettijohn (1957), and Shrock (1948) are especially useful.

The following features should be looked for and noted in the appropriate columns:

Contacts: Sharp or transitional?

Bedding Plain Traces: Flat, undulatory, rippled, or irregular? Describe wherever possible.

Thickness of Beds: The following terminology, adapted from McKee and Weir (1953), should be utilized:

Thick-bedded	120-60 cm.
Thin-bedded	60-5
Very thin-bedded	5-1
Laminated	1 cm-2 mm.
Thinly laminated	less than 2 mm.

The following features should be looked for and noted where they appear:

a. Is the thickness constant or variable? Give the maximum and minimum thicknesses.
b. Is the bedding rythmic ("cyclic") or random? Describe.
c. Is normal or inverse graded-bedding present?

The distinction of beds is, of course, very subjective because we are only examining a very narrow column. It should be assumed that

essentially horizontal planes represent bedding surfaces. There will, of course, be instances where the lithologic changes occur as "pockets" or "burrows".

Attitude and Direction of Bedding:

a. Are the beds horizontal, inclined, or curved? Measure the (apparent) dip.

b. Are the beds parallel, intersecting, or tangential to other beds? Describe. Use cross-bedding terminology whenever applicable.

Relation of Particle Properties: How are the particles oriented respective to bedding?

Disturbance of Bedding: Is folding or crumpling present? Describe.

Nodular and Concretionary Structures.

These will normally be comprised of small pellets, which may, in turn, be differentiated into oolites and pisolites. The following features should be described:

a. kinds and sizes
b. condition and distribution
c. orientation with bedding
d. internal structure
e. boundaries (sharp or transitional)

Organic Constituents.

A systematic paleontological study is not required here, but major groups of organisms and organic constituents should be identifiable in smears and with the binocular microscope. This is of major importance in any classification of marine sediments, Olausson's included. The organic constituents can be classed as Forams, Radiolaria, diatoms, gastropods, pelecypods, pteropods, algal plates, plants, and carbonaceous material. The following features should be noted:

a. kinds and sizes
b. condition (whole or broken)
c. distribution
d. orientation with bedding

Miscellaneous Features.

Any other features not already mentioned, which may be of importance in classifying the core and its units, or of general interest, should be noted and described. A partial list follows:

1. Zone of oxidation at the top of the core.
2. Voids and other open spaces.
3. Breaks, cracks, slumping and stretching caused by extrusion and handling of the core.
4. Burrows, and aggregate and composite structures.
5. Volcanic ash and pumice.
6. Detrital grains of inorganic origin.
7. Authigenic minerals, e.g., glauconite, halite, polyhalite.

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APPENDIX A

LIST OF RECOMMENDED ABBREVIATIONS

Biological Terms

burrows	burw
Forams	F
gastropod	gstr
mollusk	mlsc
organisms	org
pelecypod	plcy
plant	plt
Pteropod	Pt
preserved	prsvd
Radiolaria	R
shell (y)	shl (y)
spicules	spcl
Halimeda	Hal

Directional Terms

bottom	bt
horizontal	hor
lower	lwr
middle	mid
near	n/
parallel	//
perpendicular	I
plane	pln
uniform (ly)	unfm (y)
upper	upr
variable	var
vertical	vert

Mineralogical Terms

calcite	cal
clay	cl
dolomite	dol
dolomitic	dolic
ferruginous	fer
glauconite	glauc
limestone	ls
manganese	Mn
marcasite	mrcs
mineralization	min
pyrite	pyr
quartz	qtz
siderite	sid

Color Terms

black	blk
blue	bl
brown	brn
dark	dk
gradational	grdl
gray	gy
green	gn
light	lt
medium	md
mottle, -d	mot
olive	ol
orange	orn
stain (ing)	stn (g)
variegated	vrg
yellow	yl

Lithologic Terms

arenaceous	aren
argillaceous	argl
calcareous	calc
carbonaceous	carb
cement	cmt
clay	cl
detrital	detr
micaceous	mic
oolitic	ool
pisolitic	pis
rock (s)	rk, rx
sand (y)	sd (y)
sandstone	ss
shale	sh
siliceous	sil
silt (y)	slt (y)
tuffaceous	tuf
volcanic	volc

Quantitative Terms

abundant	abu
common	cm
concentration	conc
concentrated	contrd
disseminated	dism
flood	fld
fraction	fxn
large	lrg

light	lt
medium	md
minute	min
moderate	mod
prominent	prmt
rare	r/
scarce	scr
scattered	sct
slight (ly)	sl (y)
small	sm
some	s/
strong (ly)	strn (y)
trace	tr
uniform (ly)	unfm (y)
variable	var
very	v

Miscellaneous Terms

admixed	adm
and	&
angle	∠
apparent	apr
at	@
average	ave
complete (ly)	cpl (y)
diameter	diam
distinct	dst
estimate (d)	est
from	fr
highly	hly
irregular	irrg
material	mtrl
mixture	mxt
number	#
open space	6-s
oxidation	oxn
oxidized	ox
percent	%
partial (ly)	prt (y)
poor (ly)	pr (y)
preserved	prsvd
regular	reg
residue	res
strength (compressive)	S
similar to	~
well	w/
with	w

Textural and Structural Terms

aggregate	agr
angular	ang
bedding	bdng
coarse	crs
compact (ed)	cpt (d)
composite	comp
concretion	cncr
contact	ct
cross-bedded	x-bd
crystalline	xln
crystal	xtl
dense	ds
disseminated	dism
distributed	distrib
disturbed	dstb
fine	fn
frosted	fstd
fracture	frac
fragment	frag
gradational	grdl
graded	grd
gradually	grdy
grain	grn
granular	grlr
granule	grnl
gravel	grv
hard	hd
indurated	indur
irregular	irrg
lamina (ted)	lam (d)
layer (ed)	lyr (d)
loose	l/
massive	msv
medium	md
nodule	nod
oolite	ool
pebble	peb
pellet	pel
regular	reg
rock (s)	rk, rx
round (ed)	rnd (d)
sharp	shp
shell (y)	shl (y)
soft	sft
sorted, sorting	srt (g)
stain (ing)	stn (g)
streak	stk
stringer	strg
structure	str
texture	text
thin-bedded	t-b
tight	t/
uniform (ly)	unfm (y)
void	v/
zone	z/

APPENDIX B

COMPOSITIONAL CLASSIFICATION OF RECENT MARINE SEDIMENTS

(after Olausson, 1960)

I. Pelagic deposits

A. Oozes

1. $CaCO_3$ 30%

a. Skeletal remains of pelagic forams or pteropods lower than 30%.

aa. $CaCO_3$ = 30-60%..............................marl ooze
bb. $CaCO_3 > 60\%$..............................chalk ooze

b. Skeletal remains of pelagic formas or pteropods higher than 30%.

aa. $CaCO_3$ = 30-60%..............foraminiferal (pteropod) marl ooze
bb. $CaCO_3 > 60\%$..................Foraminiferal (pteropod) chalk ooze

2. $CaCO_3 < 30\%$. Skeletal remains of siliceous organisms 30%.

a. diatom ooze
b. radiolarian ooze

B. Red clay. $CaCO_3 < 30\%$, and the amount of siliceous skeletal remains $< 30\%$. The sediments are dominated by pelite. The red clay is considered as calcareous if $CaCO_3$ = 10-30%.

II. Terrigenous deposits

A. Organic muds. $CaCO_3$ or skeletal remains of siliceous organisms $> 30\%$.

1. $CaCO_3 > 30\%$

a. Skeletal remains of pelagic formas or pteropods $< 30\%$.

aa. $CaCO_3$ = 30-60%.......................marl mud or sand
bb. $CaCO_3 > 60\%$........................chalk mud or sand

b. Skeletal remains of pelagic formas or pteropods $> 30\%$.

aa. $CaCO_3$ = 30-60%................foraminiferal (pteropod) marl mud
bb. $CaCO_3 > 60\%$...................foraminiferal (pteropod) chalk mud

2. $CaCO_3 < 30\%$. The amount of siliceous skeletal remains 30%.

a. diatom mud
b. radiolarian mud

B. Inorganic muds. Skeletal remains of siliceous organisms $< 30\%$. $CaCO_3 < 30\%$.

1. Clayey muds. The average diameter > 5 micron. Black (blue, green, gray etc.) mud

2. Silty or sandy muds or sands. The average diameter 5 micron.

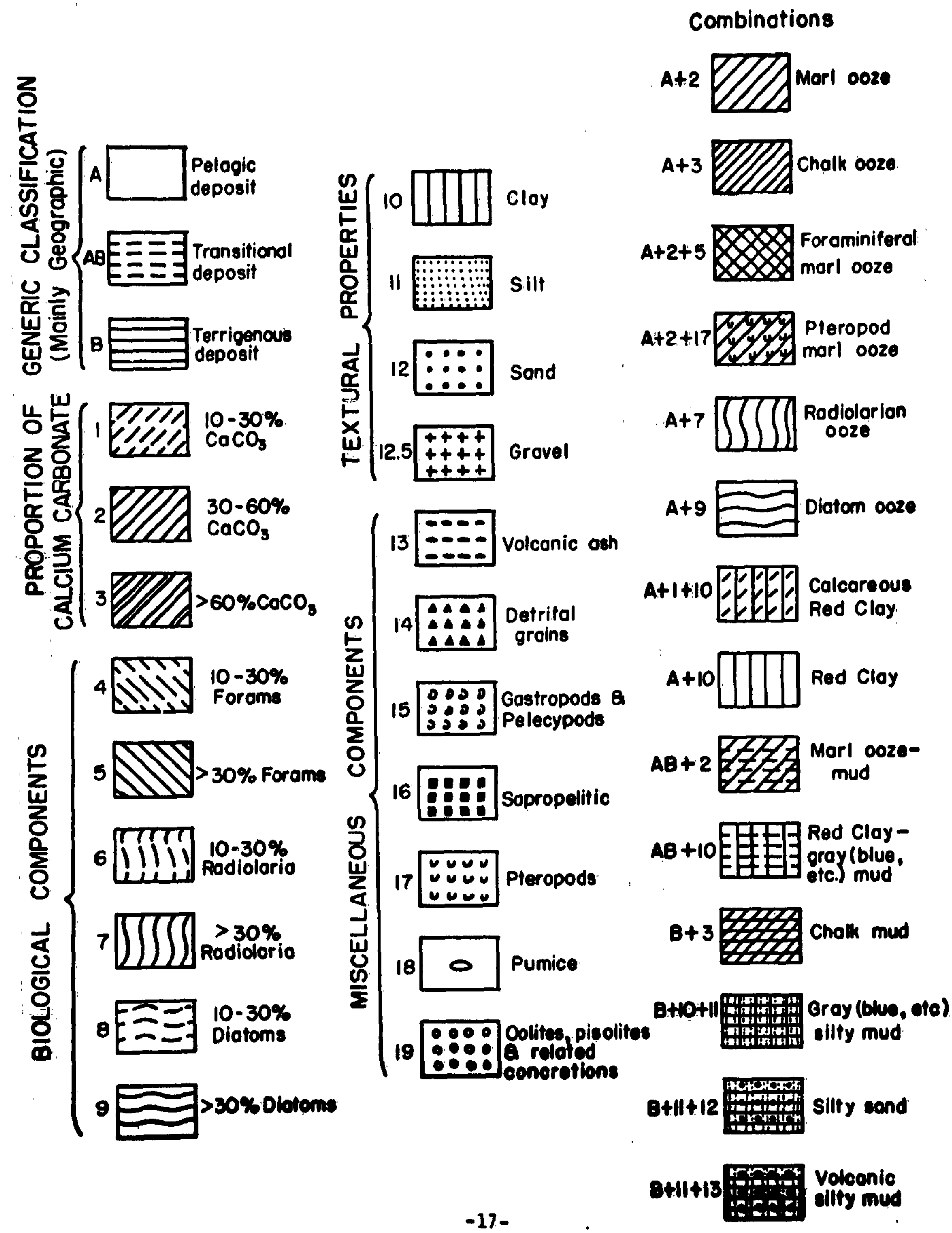
Black (blue, green, red, gray etc.) silty mud
Black (blue, green, red, gray etc.) sandy mud
Black (blue, green, red, gray etc.) silty sand

The types of deposits may be designated when necessary by adjectival terms for color, texture, and nature of organic and inorganic materials. Some of these terms are

Globigerina
coccolith
calcium carbonate
ferruginous
volcanic
detrital
siliceous
glauconitic

APPENDIX C

SCHEMATIC CLASSIFICATION OF RECENT MARINE SEDIMENTS
(Modified from Olausson, 1960)



APPENDIX D

DISTINCTION BETWEEN PELAGIC AND TERRIGENOUS MARINE SEDIMENTS

(modified after Sverdrup, Johnson and **Fleming, 1946)**

I. Constituents of Recent Marine Sediments.

TERRIGENOUS MATERIALS*/ - the breakdown products of terrigenous rocks of either igneous or sedimentary types. These can be either or both disintegration products due to mechanical breakdown of the rocks and decomposition products due to chemical breakdown.

Volcanic materials - lava fragments, volcanic glass, pumice, and mineral grains.

REMAINS OF ORGANISMS - the hard skeletal structures of marine organisms which may be either calcareous or siliceous.

Plant material - coccolith plates or **fragments of** [illegible] algal plates or fragments.

Animal materials - mainly shells.

Calcareous - Forams, corals, worms, bryozoans, brachipods, mollusks, echinoderms, (arthropods and vertebrates are mainly phosphatic).

Siliceous - diatoms and radiolarians.

INORGANIC PRECIPITATES - precipitated materials out of supersaturated solutions. Carbonates and nodules of phosphate, manganese, barite, iron, pyrite and marcasite.

Products of Chemical Transformation - altered materials from transformation of terrigenous or volcanic products. Glauconite, phosphorite, and the less easily identifiable philipsite and altered clays.

Extraterrestial Materials - black **metallic or brown siliceous** meteoric spherules.

II. Classification of Recent Marine Sediments.

The classification of terrigenous deposits is not as rigorous as that of pelagic deposits. For the pelagic deposits, use the outline of Olausson (1960) in Appendix B.

The only criteria for distinguishing terrigenous deposits from the

*/ **Bold type constituents refer to major components**

pelagic ones are texture and character. In general, the terrigenous deposits are coarser, but the coarseness in itself is not definitive unless the composition of the coarse fraction is taken into consideration. The coarse fraction of pelagic deposits consists of planktonic forams and, in rare cases, volcanic ash. The coarse fraction of terrigenous deposits consists of terrigenous materials and/or the organic1/components mentioned above, in addition to inorganic precipitates, such as fine-grained carbonate. The latter components are especially important in carbonate deposition areas such as the Bahamas.

According to Revelle (1944), pelagic and terrigenous deposits may be distinguished from one another if any of the following characteristics are present, and if caution is employed in the interpretation:

Pelagic Sediments (generally deposited at a relatively slow rate):

1. Red, brown, yellow, or white in color.

2. Less than 20% of allogenic mineral and rock particles larger than 5 microns in diameter.

3. Small amounts of neritic organic remains.

Terrigenous Sediments (generally deposited at a relatively fast rate):

1. Black, bluish, green, or gray in color.

2. More than 20% of allogenic mineral and rock particles larger than 5 microns in diameter.

3. Appreciable amounts of neritic organic remains.

The transitional deposits (AB) are those whose characteristics place them in an intermediate position between the terrigenous and the pelagic deposits.

1/ For the most part, the organics refer to the calcareous class of animal materials, but must include also the algal plates which are of plant origin.

APPENDIX E

TEXTURAL CLASSIFICATION OF TERRIGENOUS SEDIMENTS

(after Folk, 1954)

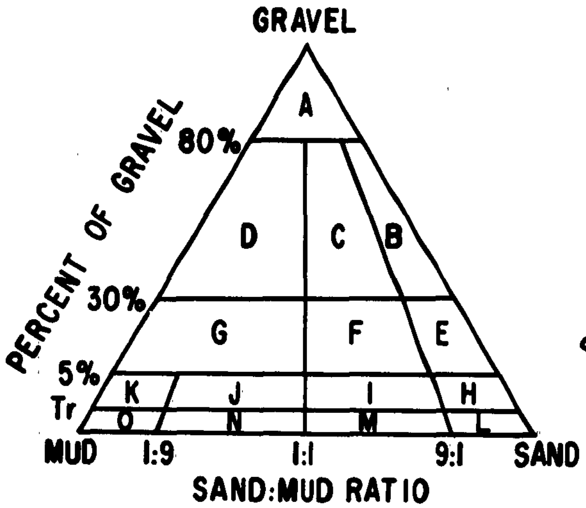


Fig. 1. The major textural groups as defined by the relative percentages of gravel, sand and mud (silt and clay).

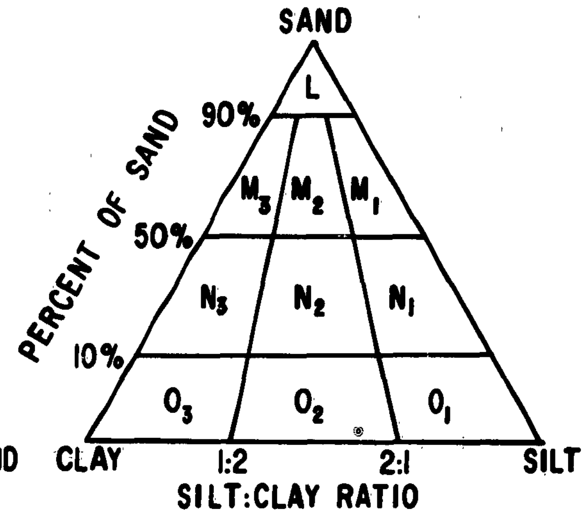


Fig. 2. Expansion of the bottom tier of Fig. 1, for sediments without gravel.

Descriptive Terms

A	gravel	N	sandy mud
B	sandy gravel	O	mud
C	muddy sandy gravel	L	sand
D	muddy gravel	M1	silty sand
E	gravelly sand	M2	muddy sand
F	gravelly muddy sand	M3	clayey sand
G	gravelly mud	N1	sandy silt
H	slightly gravelly sand	N2	sandy mud
I	slightly gravelly muddy sand	N3	sandy clay
J	slightly gravelly sandy mud	O1	silt
K	slightly gravelly mud	O2	mud
L	sand	O3	clay
M	muddy sand		

(NOTE: modify the above terms by specifying grain size).

THE MARINE LABORATORY

UNIVERSITY OF MIAMI

MIAMI 49 FLORIDA

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MG 60-I

LAT. 25°22.5' LONG. 77°56.9' STA. No. 5

SHIP R/V GERDA CRUISE 6017 AREA T.O.T.O.

DEPTH 1370 DATE 3 VII 60 SUBAREA *

FATHOGRAM No. I CORE SECTION –

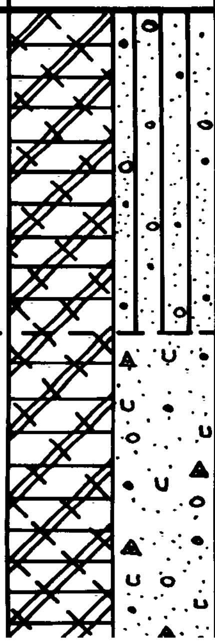
TOTAL CORE LENGTH 83cm TYPE GRAVITY

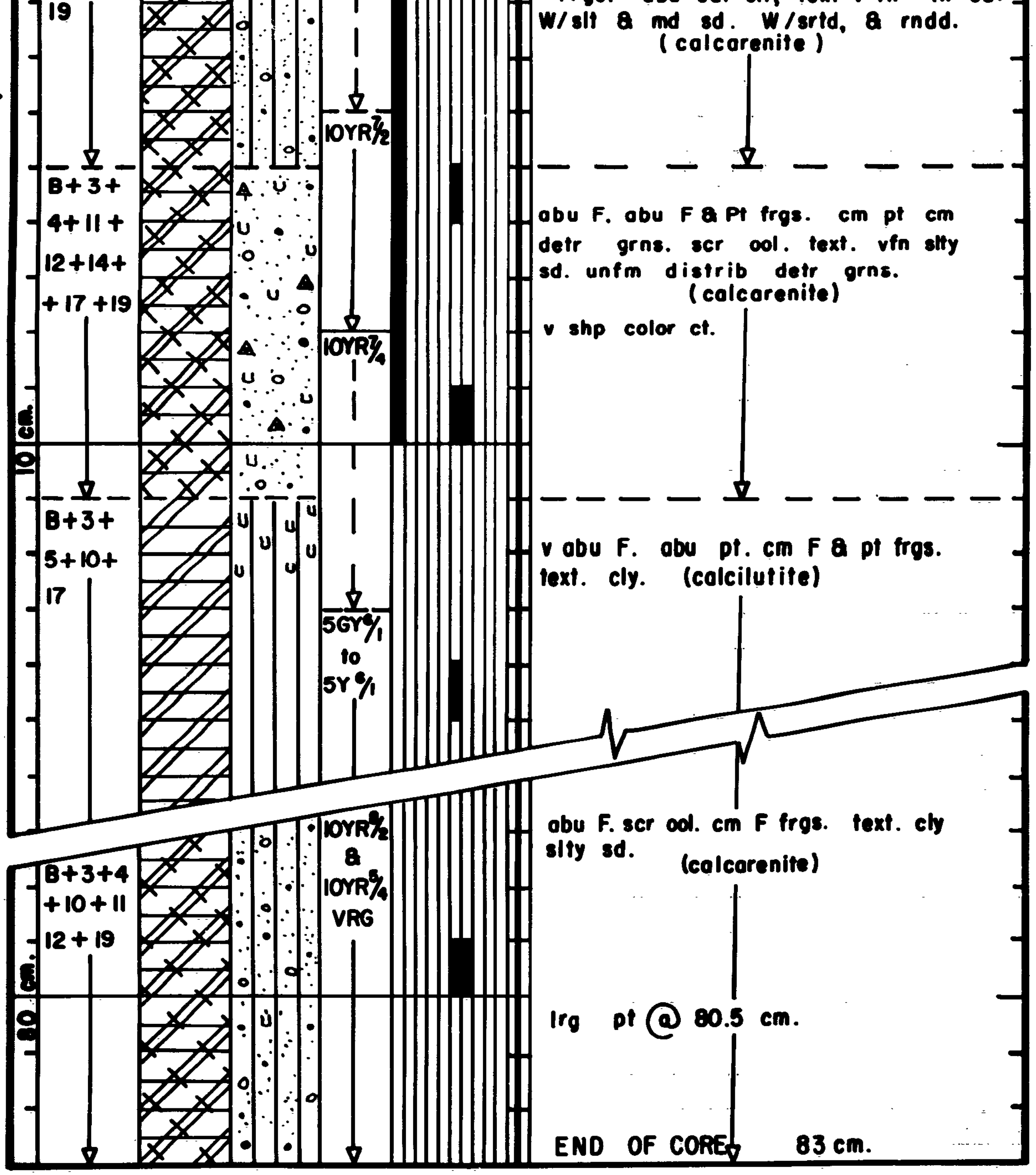
PHYSIOGRAPHIC PROVINCE BAHAMAS, B.W.I.

REMARKS

* NORTH WEST PASSAGE

By: W. CHARM

Classification	Lithology	Color	Sampling Data 1 2 3 4 5 6 7 8 9 10	DESCRIPTION
B+3+4+10+11+12+19		5YR 8/1 → 10YR 7/2		abu F. cm F. plates. scr rods. r/R. scr shl frg. scr ool. v abu cal plates & frgs. abu cal slt; text v fn - fn sd. W/slt & md sd. W/srtd, & rndd. (calcarenite)
B+3+4+11+12+14+17+19		10YR 7/2 → 10YR 7/4		abu F. abu F & Pt frgs. cm pt cm detr grns. scr ool. text. vfn slty sd. unfm distrib detr grns. (calcarenite)
				v shp color ct.


19
B+3+
4+11+
12+14+
+17+19
B+3+
5+10+
17
B+3+4
+10+11
12+19
10 cm.
80 cm.
10YR 7/2
10YR 7/4
5GY 6/1
to
5Y 6/1
10YR 8/2
&
10YR 5/4
VRG
W/slt & md sd. W/srtd, & rndd.
(calcarenite)
abu F. abu F & Pt frgs. cm pt cm
detr grns. scr ool. text. vfn slty
sd. unfm distrib detr grns.
(calcarenite)
v shp color ct.
v abu F. abu pt. cm F & pt frgs.
text. cly. (calcilutite)
abu F. scr ool. cm F frgs. text. cly
slty sd.
(calcarenite)
lrg pt @ 80.5 cm.
END OF CORE 83 cm.

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